



PATENT  
Attorney Docket No. 23742.005

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of : )  
John COOPER ) Group Art Unit: 3753  
Serial No.: 10/052,743 )  
Filed: January 23, 2002 ) Examiner: Unassigned  
For: FLUID DISTRIBUTION DEVICE )  
Assistant Commissioner for Patents  
Washington, DC 20023

**CLAIM FOR PRIORITY**

Sir:

Applicant claims foreign priority benefits under 35 U.S.C. §119, for the above-identified-  
patent application, based on the following foreign application:

GB 0101746.6, filed 23 January 2001.

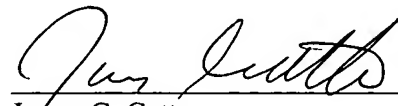
In support of this claim, a certified copy of said original foreign application is  
filed herewith.

Respectfully submitted,

Mintz Levin Cohn Ferris Glovsky and Popeo, PC

Date: March 18, 2002

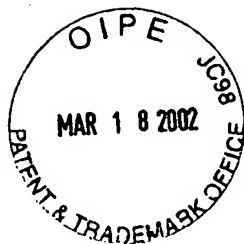
By:

  
James G. Gatto  
Registration No. 32,694

One Fountain Square  
11911 Freedom Drive, Suite 400  
Reston, VA 20190  
(703) 464-4800 (Telephone)  
(703) 464-4895 (Facsimile)



INVESTOR IN PEOPLE



The Patent Office  
Concept House  
Cardiff Road  
Newport  
South Wales  
NP10 8QQ

*Handwritten signature/initials*

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed

*Handwritten signature: M. Jenkins*

Dated 25 January 2002

**BEST AVAILABLE COPY**

The  
**Patent  
Office**

1/77

**Request for grant of a patent**

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)



The Patent Office  
Cardiff Road  
Newport  
South Wales  
NP10 8QQ

23 JAN 2001

1. Your reference	P101956GB/SAB/46209			24 JAN 01 E600285-1 D01038 F01/7700 0.00-0101746.6
2. Patent application number (The Patent Office will fill in this part)	<b>0101746.6</b>			
3. Full name, address and postcode of the or of each applicant (underline all surnames)	Lucas Industries Limited Stratford Road Solihull B90 4LA			
Patents ADP number (if you know it)	00576694002			
If the applicant is a corporate body, give the country/state of its incorporation	United Kingdom			
4. Title of the invention	FLUID DISTRIBUTION DEVICE			
5. Name of your agent (if you have one)	WITHERS & ROGERS			
"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)	Goldings House 2 Hays Lane London SE1 2HW			
Patents ADP number (if you know it)	1776001✓			
6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and (if you know it) the or each application number	Country	Priority application number (if you know it)	Date of filing (day / month / year)	
	--			
7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing (day / month / year)		
	--			
8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (answer 'Yes' if: a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. See note (d))	YES			

BEST AVAILABLE COPY

23 JAN 2001

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description 4

Claim(s) --

Abstract --

Drawing (s) 1 + (1)

10. If you are also filing any of the following, state how many against each item.

Priority documents --

Translations of priority documents --

Statement of inventorship and right to grant of a patent (Patents Form 7/77) --

Request for preliminary examination and search (Patents Form 9/77) --

Request for substantive examination (Patents Form 10/77) --

Any other documents (please specify) --

11. I/We request the grant of a patent on the basis of this application.

Signature *W. Heed Rogers* Date

WITHERS & ROGERS 22 January 2001

12. Name and daytime telephone number of person to contact in the United Kingdom Simon A Beck 0117 925 3030

# Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least six weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

# Notes

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500 505.
- Write your answers in capital letters using black ink or you may type them.
- If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.
- If you have answered 'Yes' Patents Form 7/77 will need to be filed.
- Once you have filled in the form you must remember to sign and date it.
- For details of the fee and ways to pay please contact the Patent Office.

BEST AVAILABLE COPY

**FLUID DISTRIBUTION DEVICE**

The present invention relates to a fluid distribution device. Such a device is suitable for providing a debris resistant fluid flow path within a cooling system.

Electrical machines, such as generators and motors, are becoming ever more compact. Furthermore, the currents being handled within such machines are generally increasing. Electrical generators frequently include rectifiers. The rectifiers are often provided as part of the rotor assembly and are mounted adjacent the rotor coils. There is little space within the generator assembly to provide heat sinks, and therefore it is necessary to pass a cooling fluid over the rectifiers in order to remove heat from them. It is important that heat is removed from the rectifiers as excessive heating will result in shortening of their working life span or possibly component failure.

It is known, within the context of a generator system, to mount rectifiers on a carriage which is attached to and rotates with the rotor shaft of the generator. The rotor shaft has a through bore through which cooling oil is pumped. A drilling is provided in the rotor shaft adjacent each rectifier such that oil can escape from the rotor shaft and spray onto the rectifier. There is, of course, a balance to be struck between the size of the drilling and the oil pump providing the flow of cooling oil. In most space constrained systems the maximum flow rate of a pump providing the cooling oil flow is constrained. The flow of cooling oil may have to be divided amongst many components and consequently it becomes desirable to keep the oil flow to any one component at a small a rate as is consistent with proper functioning of that component. This, in general, means that the drillings in the shaft are of a limited diameter. If the diameter of the drilling is too large, this results in preferential flow of oil through the large diameter drilling at the expense of oil flow to other components. However, with small diameter drillings there is a risk that debris in the oil could cause the drilling to become blocked thereby impeding the flow of cooling oil to the component.

According to the present invention, there is provided a fluid distribution device, comprising an inlet having a first width, an outlet having a second width less than the first width, and a separator, wherein the separator receives fluid from the inlet and directs solid matter along

**BEST AVAILABLE COPY**

a first path and substantially debris free fluid towards the outlet, and wherein at least one aperture having a third width which is less than the second width is provided intermediate the separator and the outlet.

It is thus possible to provide a distribution device which is resistant to blocking by debris.

Advantageously the inlet is dimensioned such that it is large in comparison to the expected size of debris within the fluid, and consequently is difficult to block. Debris passing through the inlet is directed towards the separator where, because of density differences between the debris and the fluid, the debris is separated from the fluid.

Advantageously the distribution device is mounted for rotation with a shaft, with the shaft passing through a substantially central bore of the distribution device. Preferably the separator comprises a first chamber of a first depth measured with respect to the central bore of the distribution device. A fluid flow path to the outlet is provided from the first chamber at a position away from the radially outer most wall thereof. Thus, as the separator rotates with the shaft, debris is forced under the action of centrifugal forces towards the radially outer most wall where it becomes held. Fluid substantially free of debris can then flow towards the outlet.

Preferably the first chamber is in fluid flow communication with a second chamber. The chambers may join at a step like interface. The interface between the first and second chambers is advantageously partially bounded by the rotor shaft in order to form an interface aperture of the third width. The interface aperture may be in the form of an elongate slot which can serve to trap debris which has not been centrifuged out of the fluid. The elongate nature of the slot means that any single piece of debris which gets trapped at the slot only blocks a relatively small portion of the slot whilst leaving the remainder of the slot open to fluid flow. The second chamber then leads to an outlet duct which directs oil towards a component to be cooled. The width of the outlet duct is greater than the width of the slot, thereby ensuring that any debris which passes through the slot will also pass through the outlet.

The present invention will further be described, by way of example, with reference to the accompanying drawing, which is a schematic cross section through a rectifier carrier including a distribution device constituting an embodiment of the present invention.

The arrangement shown in the accompanying Figure comprises a rotor shaft 2 having a through bore 4 therein which receives oil under pressure from a pump. The chain line 6 denotes the axis of rotation of the shaft 2. A rectifier carrier, generally indicated 8 is affixed to and rotates with the shaft 2. The carrier has a plurality of rectifiers attached thereto, of which only one, 10, is shown for clarity.

The carrier defines an annular bore 12 through which the shaft 2 passes in a close fit. Seals 14 are provided to form a fluid tight seal between the bore 12 of the carrier and the outer surface of the shaft 2. An aperture 16 provides an oil delivery path from the bore 4 of the shaft 2 into a first chamber 18 formed within the carrier 8. The first chamber 18 has a depth D1. A second chamber 20 having a depth D2 is also formed within the carrier 8 and is in fluid flow communication with the first chamber 18 via an interface region 22. Both chambers 18 and 20 are defined, in part, by the surface of the shaft 2. An outlet duct 24 is in fluid flow communication with the second chamber 20 and, in use, removes fluid from the second chamber 20 and directs it towards an associated rectifier 10.

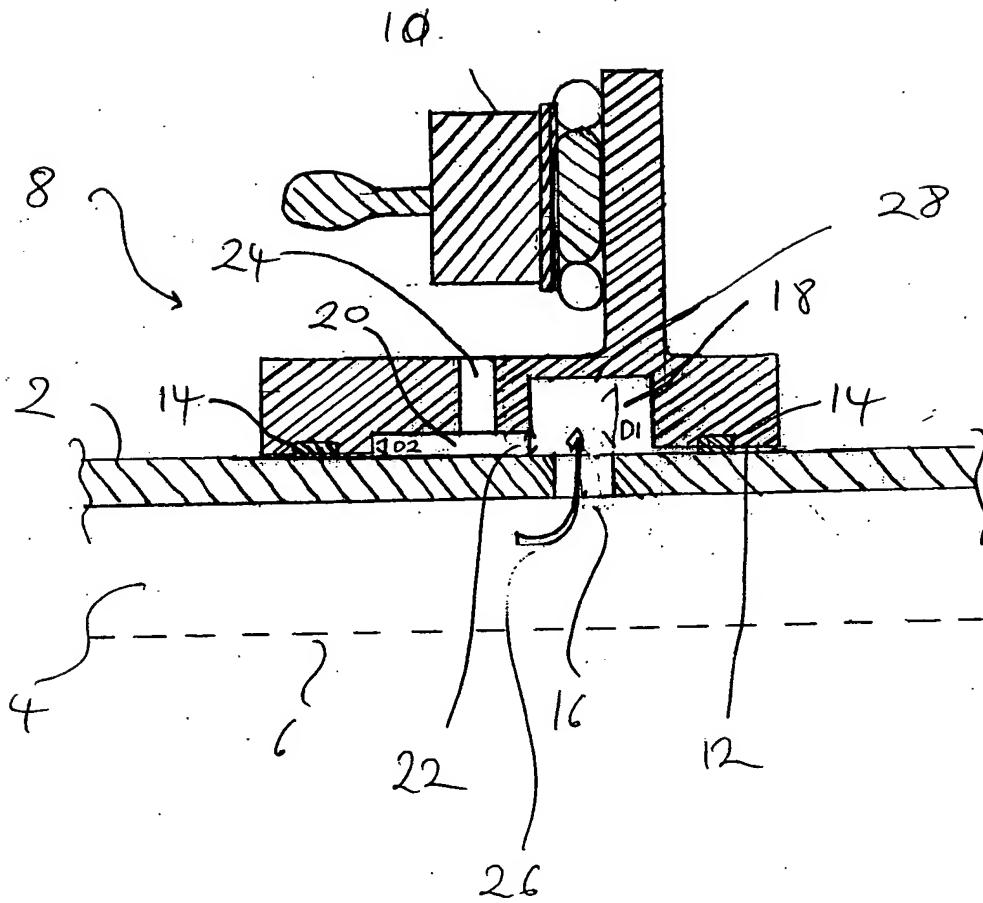
In use, the shaft and the rectifier carrier 2 are rotating and oil is provided to the bore 4 via a pump. Oil within the bore 4 flows through the passageway 16, as indicated by the arrow 26 and into the chamber 18. Because of the rotary motion of the device, particulate matter and other debris is urged towards the radially outermost wall 28 of the first chamber 18, where it becomes held by centrifugal force. The substantially debris free fluid in the chamber then flows via the elongate slot 22 from the first chamber 18 into the second chamber 20. The width of the slot 22 is equal to D2, which is a width selected to be less than the width of the outlet duct 24. Thus, debris having a width greater than D2 and which is not trapped against the wall 28 may then become engaged in or against the slot 22 where it is held. Each item of debris only blocks a small portion of the slot, and consequently flow through the slot remains substantially unaffected by the trapping of a few items of debris therein. Once fluid has passed through the slot 22 it then flows towards the outlet duct 24 and is sprayed onto the rectifier 10 in order to cool it. The diameter of the outlet duct 24 is larger

than that of slot 22 such that any debris which passes through the slot 22 is also guaranteed to pass through the outlet 24.

The cooling oil is then collected in a sump (not shown) and returned to the pump via an oil cooler for re-circulation.

It is expected that, for constructional convenience, the passage 16 and the outlet 24 will both be circular drillings. It is also likely that the first and second chambers 18 and 20 are grooves extending the full circumference of the carrier. Where the inlet 16 and outlet 24 are drillings, the width thereof should be construed as the diameter thereof. However, it will also be apparent that other geometries could be used, for example elongate slots and there the width should be construed as being the smallest dimension of the slot. Other geometries, such as ellipses are also possible and the term width should be construed in a propoitive manner.





BEST AVAILABLE COPY